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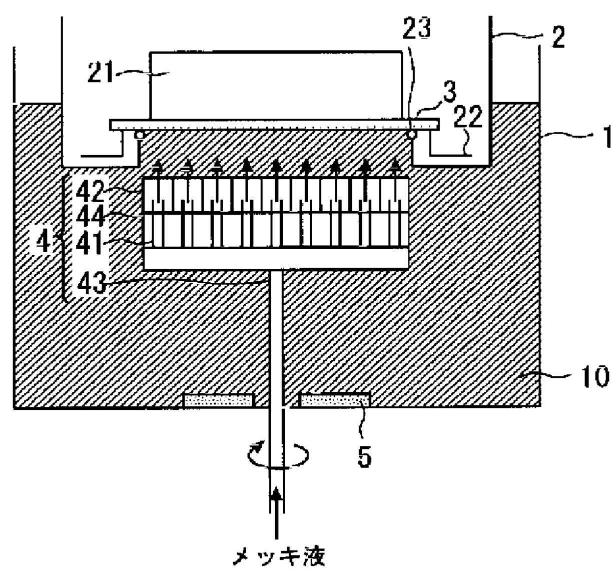
(54)【発明の名称】　めっき装置、及び半導体装置の製造方法

(57)【要約】
【課題】　半導体基板上に導電膜を均一な膜厚で形成するめっき装置を提供する。
【解決手段】　ヘッド２は、めっき液１０が満たされためっき槽１内で半導体基板３を保持する。めっき液噴出口４は、半導体基板３の近傍から半導体基板３に対して平面的にめっき液を噴出する。また、めっき液噴出口４は、めっき槽１内で回転しつつめっき液を噴出する。



【特許請求の範囲】
【請求項１】　基板上に導電膜を形成するめっき装置であって、
めっき槽と、
前記めっき槽内で前記基板を保持するヘッドと、
前記基板の近傍から前記基板に対して平面的にめっき液を噴出するめっき液噴出口と、
を備えることを特徴とするめっき装置。
【請求項２】　請求項１に記載のめっき装置において、前記めっき液噴出口は、前記めっき液を噴出する複数のノズルを有し、前記複数のノズルは平面的に配置されることを特徴とするめっき装置。
【請求項３】　請求項２に記載のめっき装置において、前記めっき液噴出口は、前記ノズルの口径よりも大きな開口を有し前記ノズルから噴出されためっき液に直進性を持たせる複数の案内管を更に有することを特徴とするめっき装置。
【請求項４】　請求項３に記載のめっき装置において、前記複数の案内管が、コリメータであることを特徴とするめっき装置。
【請求項５】　請求項２から４何れかに記載のめっき装置において、
前記めっき液噴出口が、前記めっき槽の内部で回転することを特徴とするめっき装置。
【請求項６】　請求項５に記載のめっき装置において、前記めっき液噴出口が、前記基板の中心に対して偏心して回転することを特徴とするめっき装置。
【請求項７】　請求項１から６何れかに記載のめっき装置を用いて導電膜を形成する工程を含むことを特徴とする半導体装置の製造方法。
【発明の詳細な説明】
【０００１】
【発明が属する技術分野】本発明は、半導体製造装置に係り、特に半導体基板上に導電膜を形成するめっき装置及びこのめっき装置を用いた半導体装置の製造方法に関する。
【０００２】
【従来の技術】従来より、半導体装置の製造工程において、半導体基板上に例えばＣｕ，Ａｕ，Ａｇ，Ｐｔ等からなる導電膜を形成する際に、めっき装置が用いられている。
【０００３】以下、従来のめっき装置について説明する。図４は、従来のめっき装置を説明するための断面図である。図４において、参照符号１はめっき槽、２はヘッド、２１はウェハ押さえ、２２はカソード電極、２３はシール材、３は半導体基板、５はアノード電極、６はめっき液供給配管を示している。従来のめっき装置では、めっき槽１の底部に配置されためっき液供給配管６からめっき槽１内に、金属イオン（例えば、銅イオンCu^{2+}）を含むめっき液を供給し、半導体基板３の主面上に導電膜（例えば、銅薄膜）を形成していた。
【０００４】
【発明が解決しようとする課題】しかしながら、従来のめっき装置では、めっき液供給配管６から半導体基板３までの距離が遠かった。このため、めっき液供給配管６からめっき槽１に供給されためっき液が、横方向へも拡散してしまう問題があった。従って、めっき対象である半導体基板３の近傍において、銅イオンの濃度が不均一になってしまう問題があった。
【０００５】また、継続してめっき処理を行うと、半導体基板３の近傍で徐々に銅イオンが不足してしまう問題があった。この場合も、半導体基板３の近傍において、銅イオンの濃度が不均一になってしまう。
【０００６】以上のように、半導体基板３の表面に均一な濃度でめっき液が供給されず、基板に形成された導電膜は膜厚の面内均一性が悪いという問題があった。
【０００７】本発明は、上記従来の課題を解決するためになされたもので、半導体基板上に導電膜を均一な膜厚で形成するめっき装置を提供することを目的とする。
【０００８】
【課題を解決する為の手段】請求項１の発明に係るめっき装置は、基板上に導電膜を形成するめっき装置であって、めっき槽と、前記めっき槽内で前記基板を保持するヘッドと、前記基板の近傍から前記基板に対して平面的にめっき液を噴出するめっき液噴出口と、を備えることを特徴とするものである。
【０００９】請求項２の発明に係るめっき装置は、請求項１に記載のめっき装置において、前記めっき液噴出口は、前記めっき液を噴出する複数のノズルを有し、前記複数のノズルは平面的に配置されることを特徴とするものである。
【００１０】請求項３の発明に係るめっき装置は、請求項２に記載のめっき装置において、前記めっき液噴出口は、前記ノズルの口径よりも大きな開口を有し前記ノズルから噴出されためっき液に直進性を持たせる複数の案内管を更に有することを特徴とするものである。
【００１１】請求項４の発明に係るめっき装置は、請求項３に記載のめっき装置において、前記複数の案内管が、コリメータであることを特徴とするものである。
【００１２】請求項５の発明に係るめっき装置は、請求項２から４何れかに記載のめっき装置において、前記めっき液噴出口が、前記めっき槽の内部で回転することを特徴とするものである。
【００１３】請求項６の発明に係るめっき装置は、請求項５に記載のめっき装置において、前記めっき液噴出口が、前記基板の中心に対して偏心して回転することを特徴とするものである。
【００１４】請求項７の発明に係る半導体装置の製造方法は、請求項１から６何れかに記載のめっき装置を用いて導電膜を形成する工程を含むことを特徴とするもので

ある。

【0015】

【発明の実施の形態】以下、図面を参照して本発明の実施の形態について説明する。図中、同一または相当する部分には同一の符号を付してその説明を簡略化ないし省略することがある。

【0016】実施の形態1．図1は、本発明の実施の形態1によるめっき装置を説明するための断面図である。図2は、図1に示しためっき液噴出口を説明するための断面図である。

【0017】図1及び図2において、参照符号1はめっき槽、2はヘッド、21はウェハ押さえ、22はカソード電極、23はシール材、3は半導体基板、4はめっき液噴出口、41はノズル、42は案内管、43は配管、44はフレーム、5はアノード電極を示している。

【0018】めっき槽1は、その内部にめっき液10が満たされている。また、めっき液10は、硫酸銅水溶液（$CuSO_4 \cdot H_2O$）が電気分解されたものであり、銅イオンCu^{2+}と硫酸化物イオンSO_4^{2-}とを含有している。なお、めっき槽1の断面形状は、図1のような四角形（正方形や長方形）に限られず、その四角形の底面と側面が構成する角が面取りされたような形状、若しくは逆三角形であってもよく、その形状は任意であってよい。

【0019】ヘッド2は、めっき槽1内で半導体基板3を保持するためのものである。ヘッド2は、ウェハ押さえ21、カソード電極22、及びシール材23を有している。ウェハ押さえ21は、半導体基板3を上方から押圧するためのものである。これにより、半導体基板3の表面と、カソード電極22とが接触する。カソード電極22は、めっき処理時に、半導体基板3の外周部と接触して、マイナス電位を半導体基板3に印加するためのものである。シール材23は、めっき槽1からヘッド2内部へのめっき液10の流入を防止するためのものである。シール材23は、酸性溶液に対して耐腐食性を有する例えばシリコンやケムラッツ等の材質からなるオーリング（O－ring）である。また、シール材23は、半導体基板3の外周から約3～5mmの部分と接するように、ヘッド2内に配置されている。また、ヘッド2は、図示しない駆動機構により、上下に駆動される。

【0020】半導体基板3は、ヘッド2によりめっき槽1内に保持されるめっき対象であり、例えばシリコン基板である。なお、本発明は、半導体基板3に限らず、石英基板、セラミック基板等の絶縁基板にも適用することができる（後述の実施の形態2についても同様）。半導体基板3は、ヘッド2内でウェハ押さえ21によって上方より加圧される。これにより、半導体基板3の外周部は、カソード電極22と接触する。

【0021】めっき液噴出口4は、半導体基板3の近傍から半導体基板3に対して平面的にめっき液を供給するためのものである。ここで、めっき噴出口4具体的には案内管42（後述）の先端から半導体基板3までの距離は、15cm以内とするのが好適であり、10cm以内が更に好適である。なお、案内管42をノズル41に取り付けない場合には、ノズル41の先端から半導体基板3までの距離を15cm以内、好ましくは10cm以内とする。また、ノズル41が配置された面積は、半導体基板3上に導電膜が形成される面積すなわちめっき槽1内でめっき液10と接触する半導体基板3の面積よりも大きくする。

【0022】めっき液噴出口4は、図2に示すように、複数のノズル41、複数の案内管42、配管43、及びフレーム44を有している。

【0023】ここで、複数のノズル41は、平面的（2次元的）に配置され、配管43から供給されためっき液を噴出するためのものである。従って、この複数のノズル41から半導体基板3に対して平面的にめっき液が噴出される。複数の案内管42は、ノズル41の口径よりも大きな開口をそれぞれ有し、ノズル41から噴出されためっき液に直進性を持たせるものである。すなわち、各ノズル41から噴出されためっき液を水平方向に拡散させることなく、半導体基板3に対して垂直に供給する。また、複数の案内管42は、例えばコリメータである。なお、案内管42の開口の断面形状は、円形、三角形、四角形、六角形等のうち何れの形状でもよい。また、ノズル41に案内管42を取り付けなくてもよい。

【0024】配管43は、外部のめっき液供給装置（図示省略）から供給されためっき液を、複数のノズル41に供給するためのものである。フレーム44は、めっき液噴出口4の側面に設けられ、案内管42を固定するためのものである。上記複数のノズル41、複数の案内管（コリメータ）42、配管43、及びフレーム44は、酸性溶液に対して耐腐食性を有する部材により製造されたものである。また、めっき液噴出口4は、図示しない回転機構を有している。これにより、めっき液噴出口4は、めっき槽1内で配管43を回転軸として回転する。

【0025】アノード電極5は、図示しない電源回路によりプラス電位が印加される銅電極である。これにより、アノード電極5と、カソード電極22と接する半導体基板3との間に電界が形成される。

【0026】次に、図1を参照して、上述しためっき装置の動作について説明する。

【0027】先ず、半導体基板3をヘッド2内に搬送する。次に、ウェハ押さえ21により半導体基板3を上方から押圧する。これにより、半導体基板3の外周部が、カソード電極22と接触する。

【0028】次に、ヘッド2を下方向に移動させて、半導体基板3の主面をめっき槽1のめっき液に浸漬させる。そして、カソード電極22から半導体基板3にマイナス電位を印加して、アノード電極5にプラス電位を印

加する。これにより、めっき槽１内において、アノード電極５と半導体基板３との間に電界（図示省略）が形成される。

【００２９】次に、めっき液噴出口４から半導体基板３に対して平面的にめっき液を噴出する。詳細には、外部に設けられためっき液供給装置（図示省略）から配管４３に供給されためっき液を、複数のノズル４１から噴出する。また、複数のノズル４１のそれぞれには案内管４２が被せられており、ノズル４１から噴出されためっき液は直進性を有している。すなわち、めっき液噴出口４から半導体基板３に対して、垂直かつ平面的にめっき液が噴出される。以上のようにして、半導体基板３にめっき液が供給され、半導体基板３の表面に金属が析出する。すなわち、半導体基板３の表面に、導電膜が形成される。

【００３０】以上説明したように、本実施の形態１によるめっき装置では、半導体基板３の近傍に配置されためっき液噴出口４から半導体基板３に対して平面的にめっき液を噴出するようにした。これにより、半導体基板３全面に対して、均一な濃度で金属イオン（銅イオン）が供給されるため、半導体基板３上に金属（銅）が均一に析出する。従って、半導体基板３上に均一に導電膜を形成することができる。言い換えれば、半導体基板３上に形成された導電膜の膜厚の面内均一性を向上させることができる。

【００３１】また、めっき液噴出口４を回転させることによって、半導体基板３に対して更に均一に銅イオンを供給することができる。従って、半導体基板３上に形成された導電膜の膜厚の面内均一性を更に向上させることができる。

【００３２】また、めっき液噴射口４は、半導体基板３の近傍に配置されている。このため、めっき処理を長時間継続して行う場合であっても、半導体基板３の近傍において銅イオンが不足しない。

【００３３】実施の形態２．図３は、本発明の実施の形態２によるめっき装置を説明するための断面図である。本実施の形態２によるめっき装置と、前述の実施の形態１によるめっき装置は、概略同一の構造を有している。本実施の形態２によるめっき装置と、実施の形態１によるめっき装置との相違点は、めっき液噴出口４にある。以下、この相違点について説明し、実施の形態１と重複する説明は省略する。

【００３４】図３に示すように、本実施の形態２によるめっき装置において、めっき液噴出口４の配管４３は、２度屈曲している。そして、このめっき液噴出口４は、上記屈曲した配管４３を回転軸として回転しつつめっき液を平面的に噴出する。すなわち、めっき液噴出口４は、半導体基板３の中心に対して偏心して回転する。

【００３５】上述のように、めっき液噴出口４を基板中心に対して偏心して回転させる構造としたのは、ＰＶＤ（Physical Vapor Deposition）装置において、ターゲット裏面のマグネットを偏心させて移動させて、ターゲットの利用効率を上げる概念に基づいている。

【００３６】つまり、めっき液噴射口４を効率良く使用することができる。詳細には、本実施の形態２のめっき装置において、めっき液噴出口４の直径は半導体基板３の半径よりも大きければよい。このため、めっき液噴出口４を小型化できる。従って、めっき液噴出口４から噴出するめっき液の量を低減できる。よって、半導体装置の製造コストを低減することができる。

【００３７】また、めっき液噴出口４は、半導体基板３の近傍（実施の形態１を参照）に配置され、複数のノズル４１及び複数の案内管４２を有している。このため、めっき液噴出口４から半導体基板３に対して、平面的にめっき液が供給される。

【００３８】以上のように、本実施の形態２によるめっき装置において、めっき液噴出口４は半導体基板３の中心に対して偏心して回転するとともに、めっき液を半導体基板３に対して平面的に噴出する。このめっき装置は、実施の形態１によるめっき装置と同等、若しくはそれ以上の均一性で、半導体基板３上に導電膜を形成することができる。また、めっき液噴出口４を偏心して回転させるため、めっき液噴出口４を小型化できる。従って、めっき液の噴出量を抑えることができ、半導体装置の製造コストを抑えることができる。

【００３９】

【発明の効果】本発明によれば、半導体基板の近傍から半導体基板に対して平面的にめっき液を噴出することができる。これにより、半導体基板の表面に均一な濃度でめっき液が供給される。従って、半導体基板上に導電膜を均一な膜厚で形成することができる。

【００４０】また、めっき液供給部が回転することで、半導体基板の表面に対して、より均一な濃度でめっき液を供給することができる。従って、半導体基板上に導電膜を更に均一な膜厚で形成することができる。

【００４１】また、めっき液供給部が半導体基板の中心に対して偏心して回転することによって、高い均一性で半導体基板にめっき液を供給することができる。従って、半導体基板上に形成された導電膜の膜厚の面内均一性を向上させることができる。

【図面の簡単な説明】

【図１】　本発明の実施の形態１によるめっき装置を説明するための断面図である。

【図２】　図１に示しためっき液噴出口を説明するための断面図である。

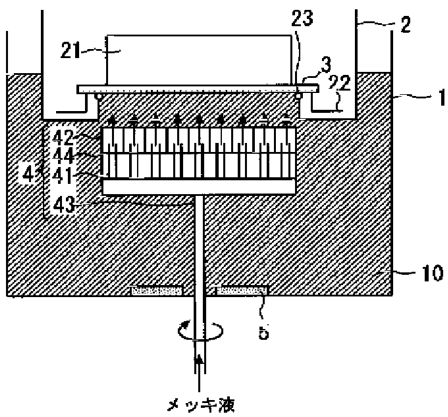
【図３】　本発明の実施の形態２によるめっき装置を説明するための断面図である。

【図４】　従来のめっき装置を説明するための断面図である。

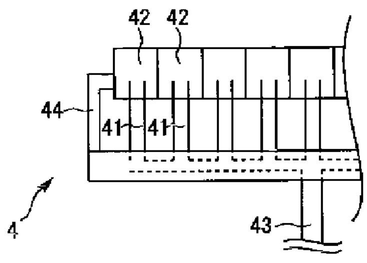
【符号の説明】

１　めっき槽、２　ヘッド、３　半導体基板、４　めっき液噴出口、５　アノード電極、１０　めっき液、２１　ウェハ押さえ、２２　カソード電極、２３シール材、４１　ノズル、４２　案内管、４３　配管、４４　フレーム。

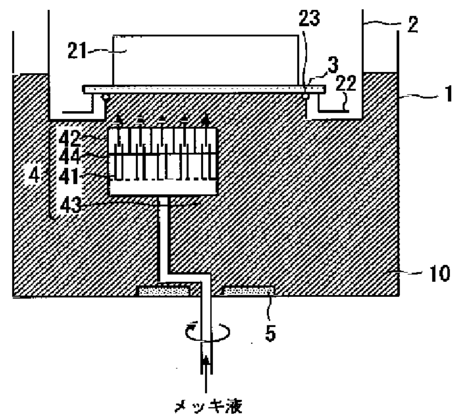
【図１】



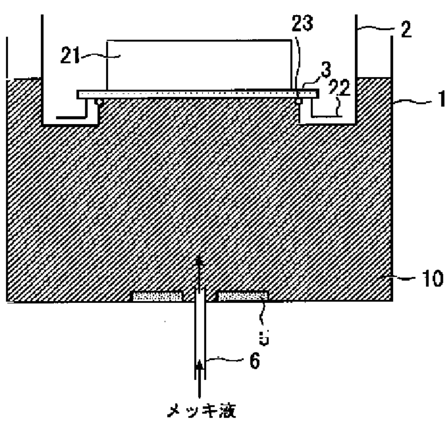
【図２】



【図３】



【図４】



<u>INFORMAL ENGLISH TRANSLATION OF</u>
<u>JAPANESE REFERENCE NO. 2002-266098</u>

TECHNICAL FIELD

[A technical field to which an invention belongs] This invention relates to a manufacturing method of a plating device which is applied to a semiconductor manufacturing device, especially forms a conducting film on a semiconductor substrate, and a semiconductor device using this plating device.

[Translation done.]

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention]However, in the conventional plating device, the distance from the plating liquid charging line 6 to the semiconductor substrate 3 was far. For this reason, there was a problem which the plating liquid supplied to the plating tub 1 from the plating liquid charging line 6 diffuses also to a transverse direction. Therefore, [near the semiconductor substrate 3 which is a candidate for plating], there was a problem to which the concentration of a copper ion becomes uneven.
[0005]When plating processing was performed continuously, there was a problem which runs short of copper ions gradually near the semiconductor substrate 3. Also in this case, the concentration of a copper ion will become uneven [near the semiconductor substrate 3].
[0006]As mentioned above, plating liquid was not supplied to the surface of the semiconductor substrate 3 by uniform concentration, but there was a problem that the conducting film formed in the substrate had the bad homogeneity within a field of thickness.
[0007]This invention was made in order to solve the above-mentioned conventional technical problem, and an object of this invention is to provide the plating device which forms a conducting film by uniform thickness on a semiconductor substrate.

[Translation done.]

EFFECT OF THE INVENTION

[Effect of the Invention]According to this invention, plating liquid can be superficially spouted to a semiconductor substrate near the semiconductor substrate. Thereby, plating liquid is supplied by uniform concentration on the surface of a semiconductor substrate. Therefore, a conducting film can be formed by uniform thickness on a semiconductor substrate.
[0040]Plating liquid can be supplied by more uniform concentration to the surface of a semiconductor substrate by a plating liquid feed zone rotating. Therefore, a conducting film can be formed by still more uniform thickness on a semiconductor substrate.
[0041]When a plating liquid feed zone carries out eccentricity and rotates to the center of a semiconductor substrate, plating liquid can be supplied to a semiconductor substrate with high homogeneity. Therefore, the homogeneity within a field of the thickness of the conducting film formed on the semiconductor substrate can be raised.

[Translation done.]

MEANS

[Means for Solving the Problem]A plating device concerning an invention of claim 1 is provided with plating liquid rocket engine jets which are the plating devices which form a conducting film on a substrate, and spout plating liquid superficially to said substrate a plating tub, a head which holds said substrate within said plating tub, and near said substrate.
[0009]A plating device concerning an invention of claim 2 has two or more nozzles for which said plating liquid rocket engine jets spout said plating liquid in the plating device according to claim 1, and said two or more nozzles are arranged superficially.
[0010]A plating device concerning an invention of claim 3 has further two or more guide pipes which give tracking to plating liquid which said plating liquid rocket engine jets have a bigger opening than a caliber of said nozzle, and blew off from said nozzle in the plating device according to claim 2.
[0011]A plating device concerning an invention of claim 4 is characterized by said two or more guide pipes being collimators in the plating device according to claim 3.
[0012]In the plating device according to any one of claims 2 to 4, said plating liquid rocket engine jets rotate a plating device concerning an invention of claim 5 inside said plating tub.
[0013]In the plating device according to claim 5, to the center of said substrate, said plating liquid rocket engine jets carry out eccentricity of the plating device concerning an invention of claim 6, and rotate it.
[0014]A manufacturing method of a semiconductor device concerning an invention of claim 7 includes a process of forming a conducting film using the plating device according to any one of claims 1 to 6.
[0015]
[Embodiment of the Invention]Hereafter, an embodiment of the invention is described with reference to drawings. Among a figure, the same numerals may be given to the portion which is the same or corresponds, and the explanation may be simplified thru/or omitted.
[0016]Embodiment 1. drawing 1 is a sectional view for explaining the plating device by the embodiment of the invention 1. Drawing 2 is a sectional view for explaining the plating liquid rocket engine jets shown in drawing 1.
[0017]in drawing 1 and drawing 2 — the reference mark 1 — a plating tub and 2 — a head and 21 — a wafer presser foot and 22 — a cathode terminal and 23 — a sealant and 3 — a semiconductor substrate and 4 — a guide pipe and 43 show piping, 44 shows a frame, and, as for a nozzle and 42, plating liquid rocket engine jets and 41 show the anode electrode 5.
[0018]As for the plating tub 1, the plating liquid 10 is filled by the inside. A copper sulfate aqueous solution ($CuSO_4$andH_2O) is electrolyzed, and the plating liquid 10 contains copper-ion Cu^{2+} and sulfuration thing ion SO_4^{2-}. It may be shape which the angle which the sectional shape of the plating tub 1 is not restricted to a quadrangle (a square and a rectangle) like drawing 1,

but the bottom and the side of the quadrangle constitute cuted off the corners, or an inverse triangle, and the shape may be arbitrary.
[0019]The head 2 is for holding the semiconductor substrate 3 within the plating tub 1. The head 2 has the wafer presser foot 21, the cathode terminal 22, and the sealant 23. The wafer presser foot 21 is for pressing the semiconductor substrate 3 from the upper part. Thereby, the surface of the semiconductor substrate 3 and the cathode terminal 22 contact. The cathode terminal 22 is for contacting the peripheral part of the semiconductor substrate 3 and impressing negative potential to the semiconductor substrate 3 at the time of plating processing. The sealant 23 is for preventing the inflow of the plating liquid 10 from the plating tub 1 to head 2 inside. For example, the sealant 23 has corrosion resistance to an acidic solution, it is an O-ring (O-ring) which consists of construction material, such as silicon and KEMURATTSU. The sealant 23 is arranged in the head 2 so that an about 3-5-mm portion may be touched from the periphery of the semiconductor substrate 3. The head 2 is driven up and down with the drive mechanism which is not illustrated.
[0020]The semiconductor substrate 3 is a candidate for plating held in the plating tub 1 by the head 2.
For example, it is a silicon substrate.
This invention is applicable not only to the semiconductor substrate 3 but insulating substrates, such as a quartz substrate and a ceramic substrate (the same may be said of the below-mentioned Embodiment 2). The semiconductor substrate 3 is pressurized by the wafer presser foot 21 from the upper part within the head 2. Thereby, the peripheral part of the semiconductor substrate 3 contacts the cathode terminal 22.
[0021]The plating liquid rocket engine jets 4 are for supplying plating liquid superficially to the semiconductor substrate 3 near the semiconductor substrate 3. Here, it is suitable for the distance from the tip of the guide pipe 42 (after-mentioned) to the semiconductor substrate 3 on a plating rocket-engine-jets 4 concrete target to be referred to as less than 15 cm, and less than 10 cm is still more suitable for it on him. In not attaching the guide pipe 42 to the nozzle 41, the distance from the tip of the nozzle 41 to the semiconductor substrate 3 shall be less than 10 cm preferably less than 15 cm. Area by which the nozzle 41 has been arranged is made larger than the area of the semiconductor substrate 3 which contacts the plating liquid 10 within the area 1, i.e., a plating tub, by which a conducting film is formed on the semiconductor substrate 3.
[0022]The plating liquid rocket engine jets 4 have two or more nozzles 41, two or more guide pipes 42, the piping 43, and the frame 44, as shown in drawing 2.
[0023]Here, two or more nozzles 41 are for spouting the plating liquid which has been arranged superficially (two-dimensional) and supplied from the piping 43. Therefore, plating liquid blows off from two or more of these nozzles 41 superficially to the semiconductor substrate 3. Two or more guide pipes 42 have a bigger opening than the caliber of the nozzle 41, respectively, and give tracking to the plating liquid which blew off from the nozzle 41. That is, it supplies vertically to the semiconductor substrate 3, without diffusing horizontally the plating liquid which blew off from each nozzle 41. Two or more guide pipes 42 are collimators, for example. Which shape may be sufficient as the sectional shape of the opening of the guide pipe 42 among circular, a triangle, a quadrangle, a hexagon, etc. It is not necessary to attach the guide pipe 42 to the nozzle 41.
[0024]The piping 43 is for supplying the plating liquid supplied from the external plating liquid feeding device (graphic display abbreviation) to two or more nozzles 41. The frame 44 is because it is provided in the side of the plating liquid rocket engine jets 4 and the guide pipe 42 is fixed. Two or more above-mentioned nozzles 41, two or more guide pipes (collimator) 42, the piping 43, and the frame 44 are manufactured by the member which has corrosion resistance to an acidic solution. The plating liquid rocket engine jets 4 have a rolling mechanism which is not illustrated. Thereby, the plating liquid rocket engine jets 4 rotate the piping 43 as the axis of rotation within the plating tub 1.

[0025]The anode electrode 5 is a copper electrode in which positive potential is impressed by the power supply circuit which is not illustrated. Thereby, an electric field is formed between the anode electrode 5 and the semiconductor substrate 3 which touches the cathode terminal 22.
[0026]Next, operation of the plating device mentioned above is explained with reference to drawing 1.
[0027]First, the semiconductor substrate 3 is conveyed in the head 2. Next, the semiconductor substrate 3 is pressed from the upper part by the wafer presser foot 21. Thereby, the peripheral part of the semiconductor substrate 3 contacts the cathode terminal 22.
[0028]Next, the head 2 is moved downward and the plating liquid of the plating tub 1 is made to immerse the principal surface of the semiconductor substrate 3. And negative potential is impressed to the semiconductor substrate 3 from the cathode terminal 22, and positive potential is impressed to the anode electrode 5. Thereby, in the plating tub 1, an electric field (graphic display abbreviation) is formed between the anode electrode 5 and the semiconductor substrate 3.
[0029]Next, plating liquid is superficially spouted from the plating liquid rocket engine jets 4 to the semiconductor substrate 3. The plating liquid supplied to the piping 43 from the plating liquid feeding device (graphic display abbreviation) formed outside in detail is spouted from two or more nozzles 41. The guide pipe 42 is put on each of two or more nozzles 41, and the plating liquid which blew off from the nozzle 41 has tracking. That is, plating liquid blows off from the plating liquid rocket engine jets 4 vertically and superficially to the semiconductor substrate 3. Plating liquid is supplied to the semiconductor substrate 3 as mentioned above, and metal deposits on the surface of the semiconductor substrate 3. That is, a conducting film is formed in the surface of the semiconductor substrate 3.
[0030]It was made to spout plating liquid superficially to the semiconductor substrate 3 in the plating device by this Embodiment 1 from the plating liquid rocket engine jets 4 arranged near the semiconductor substrate 3, as explained above. Thereby, since a metal ion (copper ion) is supplied by uniform concentration to the semiconductor substrate 3 whole surface, metal (copper) deposits uniformly on the semiconductor substrate 3. Therefore, a conducting film can be uniformly formed on the semiconductor substrate 3. In other words, the homogeneity within a field of the thickness of the conducting film formed on the semiconductor substrate 3 can be raised.
[0031]A copper ion can be supplied still more uniformly to the semiconductor substrate 3 by rotating the plating liquid rocket engine jets 4. Therefore, the homogeneity within a field of the thickness of the conducting film formed on the semiconductor substrate 3 can be raised further.
[0032]The plating liquid injection tip 4 is arranged near the semiconductor substrate 3. For this reason, even if it is a case where continue for a long time and plating processing is performed, copper ions do not run short [near the semiconductor substrate 3].
[0033]Embodiment 2. drawing 3 is a sectional view for explaining the plating device by the embodiment of the invention 2. The plating device by this Embodiment 2 and the plating device by the above-mentioned Embodiment 1 have the structure same in an outline. The point of difference between the plating device by this Embodiment 2 and the plating device by Embodiment 1 is in the plating liquid rocket engine jets 4. Hereafter, this point of difference is explained and the explanation which overlaps with Embodiment 1 is omitted.
[0034]As shown in drawing 3, in the plating device by this Embodiment 2, the piping 43 of the plating liquid rocket engine jets 4 is crooked twice. And these plating liquid rocket engine jets 4 spout plating liquid superficially, rotating the piping 43 crooked [above-mentioned] as the axis of rotation. That is, to the center of the semiconductor substrate 3, eccentricity of the plating liquid rocket engine jets 4 is carried out, and they rotate.
[0035]As mentioned above, having considered it as the structure of carrying out eccentricity of the plating liquid rocket engine jets 4, and rotating them to a substrate center, In the PVD

(Physical VaporDeposition) device, eccentricity of the magnet on the rear face of a target is carried out, it is moved, and it is based on the concept which raises the utilization efficiency of a target.

[0036]That is, the plating liquid injection tip 4 can be used efficiently. In detail, in the plating device of this Embodiment 2, the diameter of the plating liquid rocket engine jets 4 should be just larger than the radius of the semiconductor substrate 3. For this reason, the plating liquid rocket engine jets 4 can be miniaturized. Therefore, the quantity of the plating liquid spouted from the plating liquid rocket engine jets 4 can be reduced. Therefore, the manufacturing cost of a semiconductor device can be reduced.

[0037]The plating liquid rocket engine jets 4 are arranged near the semiconductor substrate 3 (see the Embodiment 1), and have two or more nozzle 41 and two or more guide pipes 42. For this reason, plating liquid is superficially supplied from the plating liquid rocket engine jets 4 to the semiconductor substrate 3.

[0038]As mentioned above, in the plating device by this Embodiment 2, the plating liquid rocket engine jets 4 spout plating liquid superficially to the semiconductor substrate 3 while carrying out eccentricity and rotating to the center of the semiconductor substrate 3. This plating device is a plating device by Embodiment 1, equivalent, or the homogeneity beyond it, and can form a conducting film on the semiconductor substrate 3. Since eccentricity of the plating liquid rocket engine jets 4 is carried out and they are rotated, the plating liquid rocket engine jets 4 can be miniaturized. Therefore, the jetting volume of plating liquid can be stopped and the manufacturing cost of a semiconductor device can be held down.

[Translation done.]

PRIOR ART

[Description of the Prior Art]Conventionally, in the manufacturing process of a semiconductor device, when forming the conducting film which consists of Cu, Au, Ag, Pt, etc. on a semiconductor substrate, the plating device is used.
[0003]Hereafter, the conventional plating device is explained. Drawing 4 is a sectional view for explaining the conventional plating device. in drawing 4 — the reference mark 1 — a plating tub and 2 — a head and 21 — a sealant and 3 show a semiconductor substrate, 5 shows an anode electrode, and, as for a cathode terminal and 23, a wafer presser foot and 22 show the plating liquid charging line 6. In the conventional plating device, the plating liquid containing a metal ion (for example, copper-ion Cu^{2+}) was supplied in the plating tub 1 from the plating liquid charging line 6 arranged at the pars basilaris ossis occipitalis of the plating tub 1, and the conducting film (for example, copper thin film) was formed on the principal surface of the semiconductor substrate 3.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1]It is a sectional view for explaining the plating device by the embodiment of the invention 1.
[Drawing 2]It is a sectional view for explaining the plating liquid rocket engine jets shown in drawing 1.
[Drawing 3]It is a sectional view for explaining the plating device by the embodiment of the invention 2.
[Drawing 4]It is a sectional view for explaining the conventional plating device.
[Description of Notations]
1 A plating tub and 2 [Piping and 44 / Frame.] A head, three semiconductor substrates, 4 plating liquid rocket engine jets, 5 anode electrodes, 10 plating liquid, and 21 A wafer presser foot, 22 cathode terminals, 23 sealants, 41 nozzles, and 42 A guide pipe and 43

[Translation done.]

* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which an invention belongs] This invention relates to the manufacturing method of the plating device which is applied to a semiconductor manufacturing device, especially forms a conducting film on a semiconductor substrate, and the semiconductor device using this plating device.
[0002]
[Description of the Prior Art]Conventionally, in the manufacturing process of a semiconductor device, when forming the conducting film which consists of Cu, Au, Ag, Pt, etc. on a semiconductor substrate, the plating device is used.
[0003]Hereafter, the conventional plating device is explained. Drawing 4 is a sectional view for explaining the conventional plating device. in drawing 4 -- the reference mark 1 -- a plating tub and 2 -- a head and 21 -- a sealant and 3 show a semiconductor substrate, 5 shows an anode electrode, and, as for a cathode terminal and 23, a wafer presser foot and 22 show the plating liquid charging line 6. In the conventional plating device, the plating liquid containing a metal ion (for example, copper-ion Cu^{2+}) was supplied in the plating tub 1 from the plating liquid charging line 6 arranged at the pars basilaris ossis occipitalis of the plating tub 1, and the conducting film (for example, copper thin film) was formed on the principal surface of the semiconductor substrate 3.
[0004]
[Problem(s) to be Solved by the Invention]However, in the conventional plating device, the distance from the plating liquid charging line 6 to the semiconductor substrate 3 was far. For this reason, there was a problem which the plating liquid supplied to the plating tub 1 from the plating liquid charging line 6 diffuses also to a transverse direction. Therefore, [near the semiconductor substrate 3 which is a candidate for plating], there was a problem to which the concentration of a copper ion becomes uneven.
[0005]When plating processing was performed continuously, there was a problem which runs short of copper ions gradually near the semiconductor substrate 3. Also in this case, the concentration of a copper ion will become uneven [near the semiconductor substrate 3].
[0006]As mentioned above, plating liquid was not supplied to the surface of the semiconductor substrate 3 by uniform concentration, but there was a problem that the conducting film formed in the substrate had the bad homogeneity within a field of thickness.
[0007]This invention was made in order to solve the above-mentioned conventional technical problem, and an object of this invention is to provide the plating device which forms a conducting film by uniform thickness on a semiconductor substrate.
[0008]
[Means for Solving the Problem]A plating device concerning an invention of claim 1 is provided

with plating liquid rocket engine jets which are the plating devices which form a conducting film on a substrate, and spout plating liquid superficially to said substrate a plating tub, a head which holds said substrate within said plating tub, and near said substrate.

[0009]A plating device concerning an invention of claim 2 has two or more nozzles for which said plating liquid rocket engine jets spout said plating liquid in the plating device according to claim 1, and said two or more nozzles are arranged superficially.

[0010]A plating device concerning an invention of claim 3 has further two or more guide pipes which give tracking to plating liquid which said plating liquid rocket engine jets have a bigger opening than a caliber of said nozzle, and blew off from said nozzle in the plating device according to claim 2.

[0011]A plating device concerning an invention of claim 4 is characterized by said two or more guide pipes being collimators in the plating device according to claim 3.

[0012]In the plating device according to any one of claims 2 to 4, said plating liquid rocket engine jets rotate a plating device concerning an invention of claim 5 inside said plating tub.

[0013]In the plating device according to claim 5, to the center of said substrate, said plating liquid rocket engine jets carry out eccentricity of the plating device concerning an invention of claim 6, and rotate it.

[0014]A manufacturing method of a semiconductor device concerning an invention of claim 7 includes a process of forming a conducting film using the plating device according to any one of claims 1 to 6.

[0015]

[Embodiment of the Invention]Hereafter, an embodiment of the invention is described with reference to drawings. Among a figure, the same numerals may be given to the portion which is the same or corresponds, and the explanation may be simplified thru/or omitted.

[0016]Embodiment 1. drawing 1 is a sectional view for explaining the plating device by the embodiment of the invention 1. Drawing 2 is a sectional view for explaining the plating liquid rocket engine jets shown in drawing 1.

[0017]in drawing 1 and drawing 2 -- the reference mark 1 -- a plating tub and 2 -- a head and 21 -- a wafer presser foot and 22 -- a cathode terminal and 23 -- a sealant and 3 -- a semiconductor substrate and 4 -- a guide pipe and 43 show piping, 44 shows a frame, and, as for a nozzle and 42, plating liquid rocket engine jets and 41 show the anode electrode 5.

[0018]As for the plating tub 1, the plating liquid 10 is filled by the inside. A copper sulfate aqueous solution ($CuSO_4$andH_2O) is electrolyzed, and the plating liquid 10 contains copper-ion Cu^{2+} and sulfuration thing ion SO_4^{2-}. It may be shape which the angle which the sectional shape of the plating tub 1 is not restricted to a quadrangle (a square and a rectangle) like drawing 1, but the bottom and the side of the quadrangle constitute cuted off the corners, or an inverse triangle, and the shape may be arbitrary.

[0019]The head 2 is for holding the semiconductor substrate 3 within the plating tub 1. The head 2 has the wafer presser foot 21, the cathode terminal 22, and the sealant 23. The wafer presser foot 21 is for pressing the semiconductor substrate 3 from the upper part. Thereby, the surface of the semiconductor substrate 3 and the cathode terminal 22 contact. The cathode terminal 22 is for contacting the peripheral part of the semiconductor substrate 3 and impressing negative potential to the semiconductor substrate 3 at the time of plating processing. The sealant 23 is for preventing the inflow of the plating liquid 10 from the plating tub 1 to head 2 inside. For example, the sealant 23 has corrosion resistance to an acidic solution, it is an O-ring (O-ring) which consists of construction material, such as silicon and KEMURATTSU. The sealant 23 is arranged in the head 2 so that an about 3-5-mm portion may be touched from the periphery of the semiconductor substrate 3. The head 2 is driven up and down with the drive mechanism which is not illustrated.

[0020]The semiconductor substrate 3 is a candidate for plating held in the plating tub 1 by the head 2, for example, is a silicon substrate. This invention is applicable not only to the semiconductor substrate 3 but insulating substrates, such as a quartz substrate and a ceramic substrate (the same may be said of the below-mentioned Embodiment 2). The semiconductor substrate 3 is pressurized by the wafer presser foot 21 from the upper part within the head 2. Thereby, the peripheral part of the semiconductor substrate 3 contacts the cathode terminal 22.
[0021]The plating liquid rocket engine jets 4 are for supplying plating liquid superficially to the semiconductor substrate 3 near the semiconductor substrate 3. Here, it is suitable for the distance from the tip of the guide pipe 42 (after-mentioned) to the semiconductor substrate 3 on a plating rocket-engine-jets 4 concrete target to be referred to as less than 15 cm, and less than 10 cm is still more suitable for it on him. In not attaching the guide pipe 42 to the nozzle 41, the distance from the tip of the nozzle 41 to the semiconductor substrate 3 shall be less than 10 cm preferably less than 15 cm. Area by which the nozzle 41 has been arranged is made larger than the area of the semiconductor substrate 3 which contacts the plating liquid 10 within the area 1, i.e., a plating tub, by which a conducting film is formed on the semiconductor substrate 3.
[0022]The plating liquid rocket engine jets 4 have two or more nozzles 41, two or more guide pipes 42, the piping 43, and the frame 44, as shown in drawing 2.
[0023]Here, two or more nozzles 41 are for spouting the plating liquid which has been arranged superficially (two-dimensional) and supplied from the piping 43. Therefore, plating liquid blows off from two or more of these nozzles 41 superficially to the semiconductor substrate 3. Two or more guide pipes 42 have a bigger opening than the caliber of the nozzle 41, respectively, and give tracking to the plating liquid which blew off from the nozzle 41. That is, it supplies vertically to the semiconductor substrate 3, without diffusing horizontally the plating liquid which blew off from each nozzle 41. Two or more guide pipes 42 are collimators, for example. Which shape may be sufficient as the sectional shape of the opening of the guide pipe 42 among circular, a triangle, a quadrangle, a hexagon, etc. It is not necessary to attach the guide pipe 42 to the nozzle 41.
[0024]The piping 43 is for supplying the plating liquid supplied from the external plating liquid feeding device (graphic display abbreviation) to two or more nozzles 41. The frame 44 is because it is provided in the side of the plating liquid rocket engine jets 4 and the guide pipe 42 is fixed. Two or more above-mentioned nozzles 41, two or more guide pipes (collimator) 42, the piping 43, and the frame 44 are manufactured by the member which has corrosion resistance to an acidic solution. The plating liquid rocket engine jets 4 have a rolling mechanism which is not illustrated. Thereby, the plating liquid rocket engine jets 4 rotate the piping 43 as the axis of rotation within the plating tub 1.
[0025]The anode electrode 5 is a copper electrode in which positive potential is impressed by the power supply circuit which is not illustrated. Thereby, an electric field is formed between the anode electrode 5 and the semiconductor substrate 3 which touches the cathode terminal 22.
[0026]Next, operation of the plating device mentioned above is explained with reference to drawing 1.
[0027]First, the semiconductor substrate 3 is conveyed in the head 2. Next, the semiconductor substrate 3 is pressed from the upper part by the wafer presser foot 21. Thereby, the peripheral part of the semiconductor substrate 3 contacts the cathode terminal 22.
[0028]Next, the head 2 is moved downward and the plating liquid of the plating tub 1 is made to immerse the principal surface of the semiconductor substrate 3. And negative potential is impressed to the semiconductor substrate 3 from the cathode terminal 22, and positive potential is impressed to the anode electrode 5. Thereby, in the plating tub 1, an electric field (graphic display abbreviation) is formed between the anode electrode 5 and the semiconductor substrate 3.
[0029]Next, plating liquid is superficially spouted from the plating liquid rocket engine jets 4 to the semiconductor substrate 3. The plating liquid supplied to the piping 43 from the plating liquid

feeding device (graphic display abbreviation) formed outside in detail is spouted from two or more nozzles 41. The guide pipe 42 is put on each of two or more nozzles 41, and the plating liquid which blew off from the nozzle 41 has tracking. That is, plating liquid blows off from the plating liquid rocket engine jets 4 vertically and superficially to the semiconductor substrate 3. Plating liquid is supplied to the semiconductor substrate 3 as mentioned above, and metal deposits on the surface of the semiconductor substrate 3. That is, a conducting film is formed in the surface of the semiconductor substrate 3.
[0030]It was made to spout plating liquid superficially to the semiconductor substrate 3 in the plating device by this Embodiment 1 from the plating liquid rocket engine jets 4 arranged near the semiconductor substrate 3, as explained above. Thereby, since a metal ion (copper ion) is supplied by uniform concentration to the semiconductor substrate 3 whole surface, metal (copper) deposits uniformly on the semiconductor substrate 3. Therefore, a conducting film can be uniformly formed on the semiconductor substrate 3. In other words, the homogeneity within a field of the thickness of the conducting film formed on the semiconductor substrate 3 can be raised.
[0031]A copper ion can be supplied still more uniformly to the semiconductor substrate 3 by rotating the plating liquid rocket engine jets 4. Therefore, the homogeneity within a field of the thickness of the conducting film formed on the semiconductor substrate 3 can be raised further.
[0032]The plating liquid injection tip 4 is arranged near the semiconductor substrate 3. For this reason, even if it is a case where continue for a long time and plating processing is performed, copper ions do not run short [near the semiconductor substrate 3].
[0033]Embodiment 2. drawing 3 is a sectional view for explaining the plating device by the embodiment of the invention 2. The plating device by this Embodiment 2 and the plating device by the above-mentioned Embodiment 1 have the structure same in an outline. The point of difference between the plating device by this Embodiment 2 and the plating device by Embodiment 1 is in the plating liquid rocket engine jets 4. Hereafter, this point of difference is explained and the explanation which overlaps with Embodiment 1 is omitted.
[0034]As shown in drawing 3, in the plating device by this Embodiment 2, the piping 43 of the plating liquid rocket engine jets 4 is crooked twice. And these plating liquid rocket engine jets 4 spout plating liquid superficially, rotating the piping 43 crooked [above-mentioned] as the axis of rotation. That is, to the center of the semiconductor substrate 3, eccentricity of the plating liquid rocket engine jets 4 is carried out, and they rotate.
[0035]As mentioned above, having considered it as the structure of carrying out eccentricity of the plating liquid rocket engine jets 4, and rotating them to a substrate center, In the PVD (Physical VaporDeposition) device, eccentricity of the magnet on the rear face of a target is carried out, it is moved, and it is based on the concept which raises the utilization efficiency of a target.
[0036]That is, the plating liquid injection tip 4 can be used efficiently. In detail, in the plating device of this Embodiment 2, the diameter of the plating liquid rocket engine jets 4 should be just larger than the radius of the semiconductor substrate 3. For this reason, the plating liquid rocket engine jets 4 can be miniaturized. Therefore, the quantity of the plating liquid spouted from the plating liquid rocket engine jets 4 can be reduced. Therefore, the manufacturing cost of a semiconductor device can be reduced.
[0037]The plating liquid rocket engine jets 4 are arranged near the semiconductor substrate 3 (see the Embodiment 1), and have two or more nozzle 41 and two or more guide pipes 42. For this reason, plating liquid is superficially supplied from the plating liquid rocket engine jets 4 to the semiconductor substrate 3.
[0038]As mentioned above, in the plating device by this Embodiment 2, the plating liquid rocket engine jets 4 spout plating liquid superficially to the semiconductor substrate 3 while carrying out eccentricity and rotating to the center of the semiconductor substrate 3. This plating device is a

plating device by Embodiment 1, equivalent, or the homogeneity beyond it, and can form a conducting film on the semiconductor substrate 3. Since eccentricity of the plating liquid rocket engine jets 4 is carried out and they are rotated, the plating liquid rocket engine jets 4 can be miniaturized. Therefore, the jetting volume of plating liquid can be stopped and the manufacturing cost of a semiconductor device can be held down.

[0039]

[Effect of the Invention]According to this invention, plating liquid can be superficially spouted to a semiconductor substrate near the semiconductor substrate. Thereby, plating liquid is supplied by uniform concentration on the surface of a semiconductor substrate. Therefore, a conducting film can be formed by uniform thickness on a semiconductor substrate.

[0040]Plating liquid can be supplied by more uniform concentration to the surface of a semiconductor substrate by a plating liquid feed zone rotating. Therefore, a conducting film can be formed by still more uniform thickness on a semiconductor substrate.

[0041]When a plating liquid feed zone carries out eccentricity and rotates to the center of a semiconductor substrate, plating liquid can be supplied to a semiconductor substrate with high homogeneity. Therefore, the homogeneity within a field of the thickness of the conducting film formed on the semiconductor substrate can be raised.

[Translation done.]

CLAIMS

[Claim(s)]
[Claim 1]A plating device which forms a conducting film on a substrate, comprising:
A plating tub.
Plating liquid rocket engine jets which spout plating liquid superficially to said substrate a head holding said substrate, and near said substrate within said plating tub.

[Claim 2]A plating device, wherein said plating liquid rocket engine jets have two or more nozzles which spout said plating liquid in the plating device according to claim 1 and said two or more nozzles are arranged superficially.
[Claim 3]A plating device, wherein said plating liquid rocket engine jets have further two or more guide pipes which give tracking to plating liquid which has a bigger opening than a caliber of said nozzle, and blew off from said nozzle in the plating device according to claim 2.
[Claim 4]A plating device characterized by said two or more guide pipes being collimators in the plating device according to claim 3.
[Claim 5]A plating device with which said plating liquid rocket engine jets are characterized by rotating inside said plating tub in the plating device according to any one of claims 2 to 4.
[Claim 6]A plating device, wherein said plating liquid rocket engine jets carry out eccentricity and rotate to the center of said substrate in the plating device according to claim 5.
[Claim 7]A manufacturing method of a semiconductor device including a process of forming a conducting film using the plating device according to any one of claims 1 to 6.

[Translation done.]